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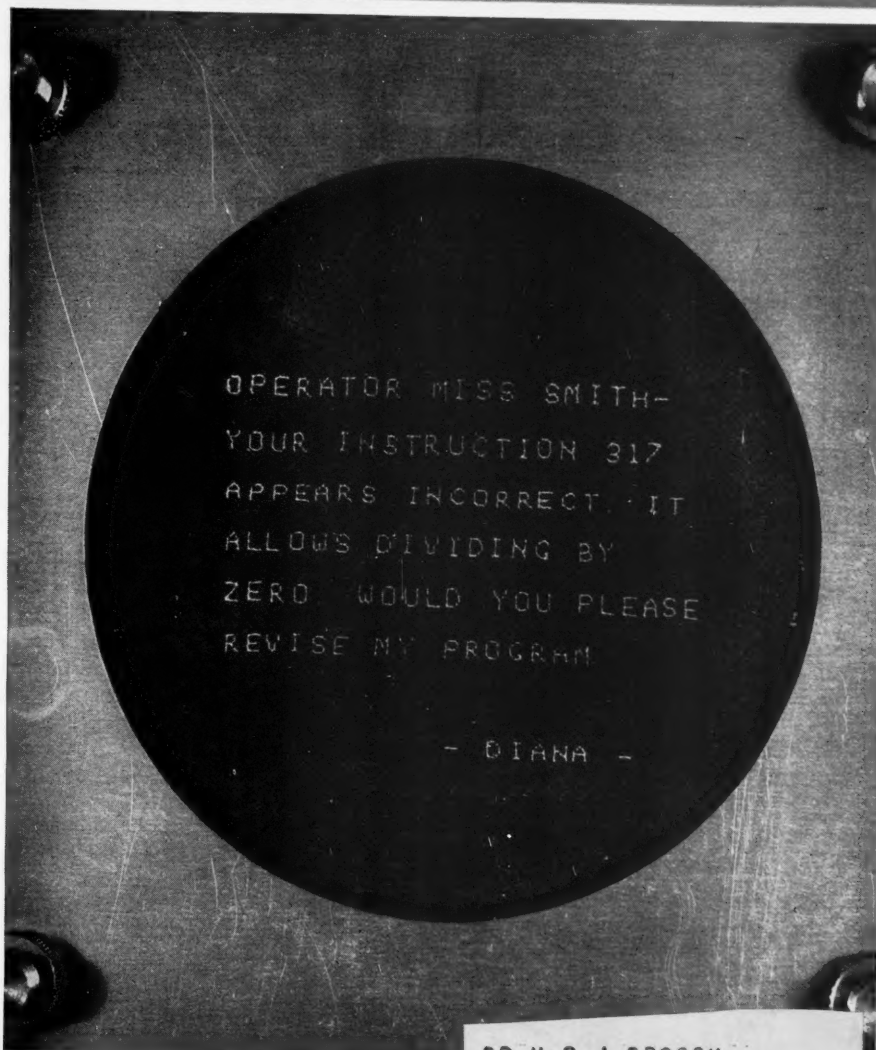
COMPUTERS
and AUTOMATION

TA PROCESSING • CYBERNETICS • ROBOTS

A PICTORIAL MANUAL ON OMPUTERS

Part 1



DECEMBER 1957
•
OL. 6 - NO. 12

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SCOTTSDALE ARIZONA
12 SB
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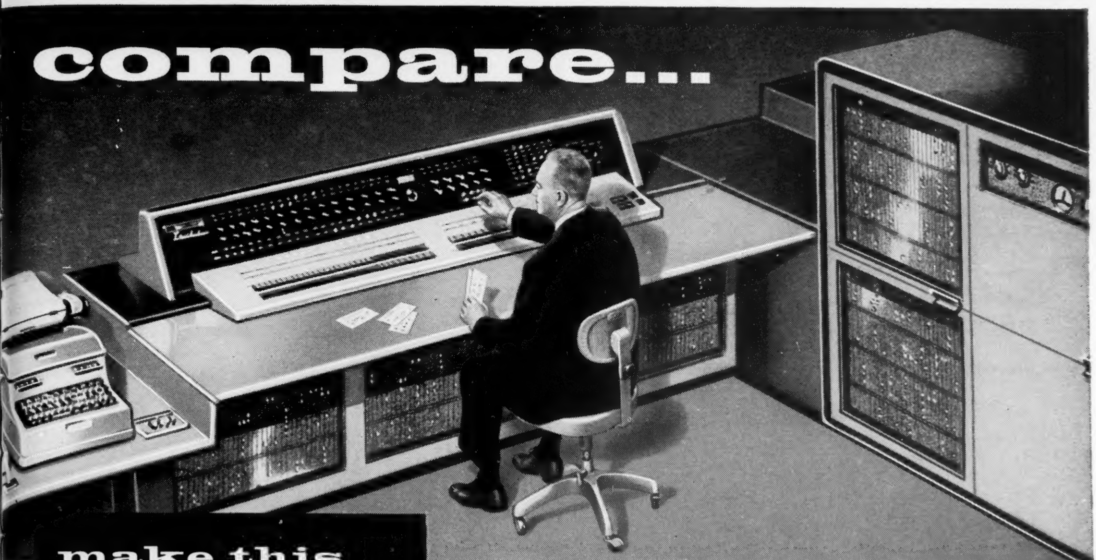
compare...



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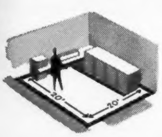

1/10 THE FLOOR SPACE. The complete Transac S-2000 system will fit into a 20′ x 20′ floor space. A tremendous economic advantage where space is at a premium.

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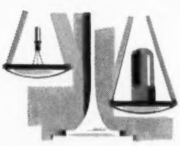

LESS THAN 1/10 THE WEIGHT. Transac actually weighs less than a comparable area of filing cabinets.

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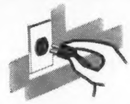

1/10 THE POWER CONSUMPTION. All transistor circuitry operates on 7-10 kilowatts as opposed to the 70-100 kilowatts required by vacuum tube systems. Transac S-2000 plugs into conventional 110V outlets.

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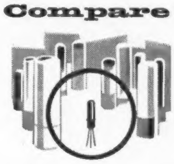

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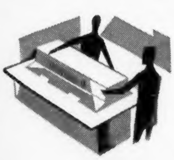
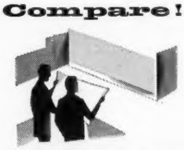


MOVEABLE. Transac S-2000 can be easily moved from place-to-place if you find it necessary to relocate.

Compare!



NO EXPENSIVE SITE PREPARATION. No special reinforcing or ducting of floors, installation of power lines, etc., are necessary for quick installation or relocation of Transac S-2000.

Compare!

NO COSTLY AIR CONDITIONING. Transistors generate practically no heat. Transac S-2000 needs little air conditioning as compared to the 40 tons or more required by vacuum tube systems.

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COMPUTERS

and AUTOMATION

DATA PROCESSING • CYBERNETICS • ROBOTS

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September 1951

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ANNUAL INDEX TO "COMPUTERS AND AUTOMATION"

PART 1

This index covers information published in the twelve issues of **Computers and Automation**, vol. 5, no. 12, Dec. 1956, to vol. 6, no. 11, Nov. 1957. In order not to delay the current issue, Dec. 1957, it has not been included in this index. The last part of each entry gives: volume/number (month of issue), page number.

Part 2, for lack of space in this issue, will be published in the January issue.

[Please turn to page 26]

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Readers' and Editor's Forum

A PICTORIAL MANUAL ON COMPUTERS

NOWADAYS THERE IS no dearth of words on what goes in a computer or data processor, a machine that handles information automatically in long sequences of reasoning operations. But there is apparently some scarcity of good pictures to explain the machines, the accessories, and the components. People distant from an installation of computers and data processors — especially students in a college or high school — may well wonder what the various kinds of hardware actually look like. To meet this need, this issue of "Computers and Automation" and the next one present a report for which the theme is: "Computers and Data Processing Presented in Pictures."

At the beginning of October we sent out a mailing to all the computer organizations that we had a record of, asking for pictures for the pictorial manual on computers. We received altogether many helpful contributions, amounting to a stack nearly a foot high, coming from approximately 85 organizations. We express our thanks and appreciation to all those organizations who were kind enough to help us.

Because of the great number of excellent pictures, we decided to present the report in two issues, so as to be able to publish twice as much as otherwise we would be able to. Even so, many good pictures will need to be postponed until later issues.

Part 1 of the report published in this issue concentrates upon whole systems and their accessories, including input and output. Part 2 of the report, which will be published in the January issue, will concentrate on components. But we do not expect that the decision will be exactly logical or precisely consistent, because a photograph always shows more than one idea.

Selection of Pictures

We have tried to select pictures that answer questions, pictures that explain or illustrate an idea, pictures that show how something works or operates. We have tried to answer such questions as: What does a . . . look like? What goes into a . . . ? How is a . . . made? How does a . . . operate? In some cases we were fortunate to be able to find pictures that had striking beauty of form or composition or design, or gave a great deal of information. We have tried to avoid pictures that show only the outside, only the smooth featureless cover that conceals something much more interesting.

If your editor could have his way, he would pass a law that all computers and their components should have transparent covers and contain lights within that would go on and off as the machine operates. And he would also legislate that the potting compound for all potted components should be transparent. It is bad enough to have human brains hidden under hair and skin and bone, and in complete darkness, without also hiding the mechanical simulators of brains in such a way that they too cannot easily be looked at and watched.

GREETINGS TO COMPUTERS

FOR CHRISTMAS, WE wish our subscribers, our readers, and all computer people:

$$\begin{array}{rr} & \mathrm{A} \\ + & \mathrm{VERY} \\ + & \mathrm{HAPPY} \\ \hline = & \mathrm{PLEDP} \end{array} \qquad \begin{array}{rr} & \mathrm{YEAR} \\ + & \mathrm{AHEAD} \\ \hline = & \mathrm{MOPDR} \end{array}$$

$$\mathrm{ID} = \mathrm{YO}$$

and 5741 2641 1280 320 52. (Solve for the digits; each letter stands for just one digit 0 to 9, although one digit may be represented by more than one letter.)

This is a Numble, a number puzzle for nimble minds. For hints for solution if needed, write us. The solution will appear in January.

We repeat our annual challenge to automatic computers — to solve this kind of problem by an automatic program. The challenge, offered now for the fourth December, remains unanswered so far as we know.

FRONT COVER: SYMBOL GENERATOR AND VIEWER

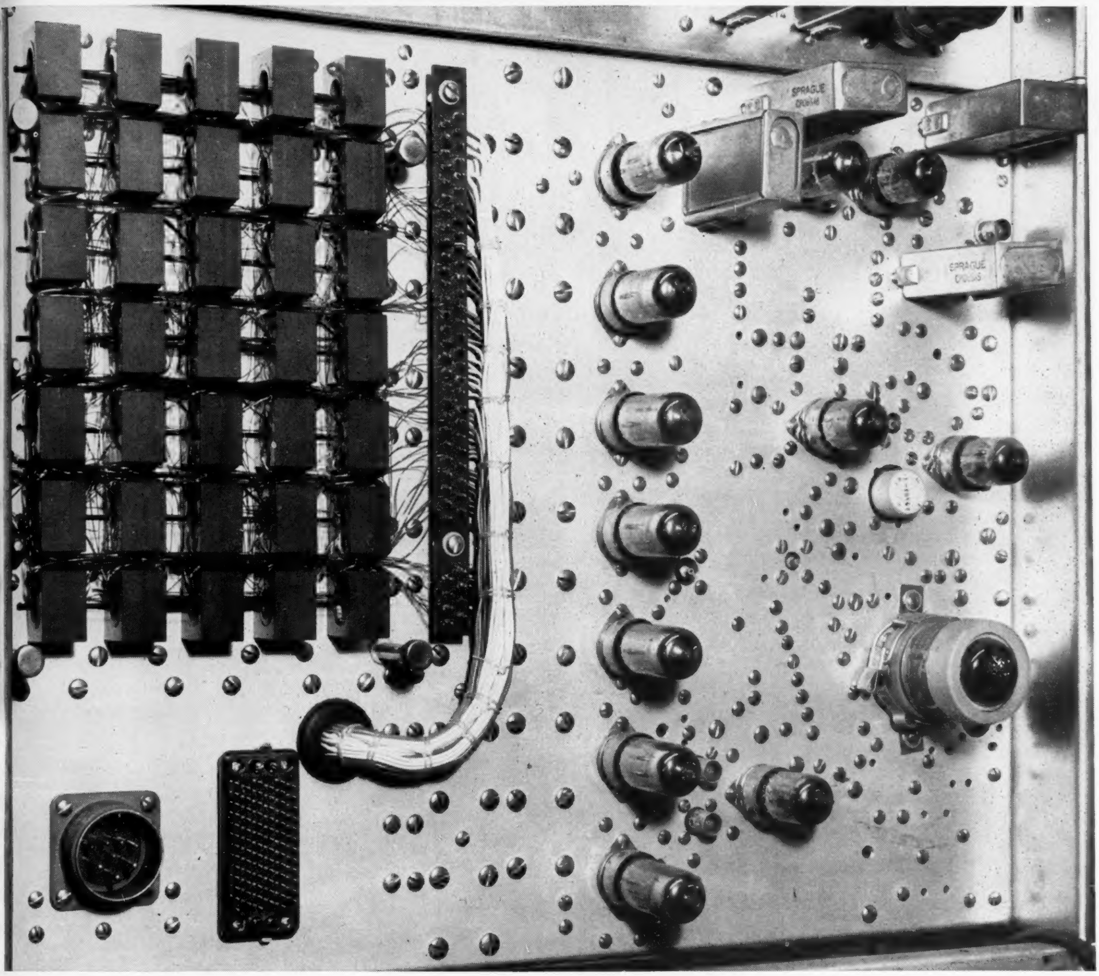
THE FRONT COVER of this issue shows a certain output device for an automatic computer, called a "symbol generator and viewer." The screen of the picture tube shown will present as many as 10,000 characters per second. Each character is formed by an array of bright spots, a selection from a rectangular array of a total of 35 spots, five wide by seven deep. For a capital letter T, for example, the selection is five spots across the top and six more spots down through the middle. This symbol generator and viewer is made by the Computer Products Division of Laboratory for Electronics, Boston; it is a part of the automatic computer Diana, and can be obtained separately.

In order to accomplish the selection of any letter or digit, the chassis controlling the viewer (see the figure on page 9) contains a corresponding rectangular array of 35 magnetic cores. To make a T in this array, a wire is threaded through those cores that correspond with the eleven spots, and is then brought out to the terminal board at the right of the array. This terminal board has 64 terminals; and waiting for use at each one of these terminals is any one of 64 selections of cores, 64 patterns forming letters, digits, or other symbols. The scanning circuit scans the core matrix at the rate of 35 cores in 100 microseconds in a regular order. Whenever a core is connected to the terminal, a pulse is sent along the wire leaving the terminal board; whenever a core is not connected, no pulse is sent. In this way, each symbol is generated as a sequence of 35 pulses or absences of pulses. As any signal, after gating, is received at the viewer, the beam is modulated light or dark depending on the presence or absence of a pulse.

The message which appears on the viewer should read "Operator Miss Smith — Your instruction 317 appears incorrect. It allows dividing by zero. Would you

[Please turn to page 9]

[Continued from page 7]



please revise my program? — Diana — ." The words for such a message (with a blank for specifying the number of an instruction), and similar words for other messages, can of course be stored in the registers of an automatic computer, for use when a program is being checked. Then the automatic computer can draw them out of its memory and use them on appropriate occasions, depending on the program-checking routine.

The machine in this case displays education, and simulates thinking and conversation. The degree of simulation can in theory be carried out to such an extent that a human being in another room, talking to the machine on a teletype, could be mystified for more than a full half hour, wondering whether he is conversing with a human being or a machine.

NON-NUCLEAR ENGINEERING PROBLEMS IN SHIPBUILDING SOLVED BY HIGH SPEED AUTOMATIC COMPUTERS

William Hetzel
Atomic Power Research Dept.
Newport News Shipbuilding and Dry Dock Co.
Newport News, Va.

WHAT NON-NUCLEAR engineering problems in shipbuilding are being solved by high speed automatic computers? What types of machines are they being solved on? Where can information be gotten about these problems? To get answers to these questions a questionnaire was sent to several shipyards, universities, and research centers.

Below is a list of such problems, type machine solved on, name of the person to contact, and his company.

"Weights and Moments," "Tank Capacity Calibration," "Tank Area Characteristics," "Ship Displacement," and "Ship Waterline Characteristics," IBM 607 Model 5, F. A. Dooley, Alabama Dry Dock and Shipbuilding Corporation, P.O. Box 190, Mobile, Alabama.

"Shock Isolators," general purpose analog. "Shock Spectra" and "Normal Mode Calculations," NAREC, Dr. Horace M. Trent, Head, Applied Mathematics Branch, U.S. Naval Research Laboratory, Washington 25, D.C.

"Weights and Moments," "Ullage Tables," "Form Calculations," "Pipe Stress," IBM 650. "Large Ship Maneuvering," "Torsional Vibration of Turbine–Reduction Gear-Generator Systems," "Compartment Pres-

[Please turn to page 27]

A PICTORIAL MANUAL ON COMPUTERS

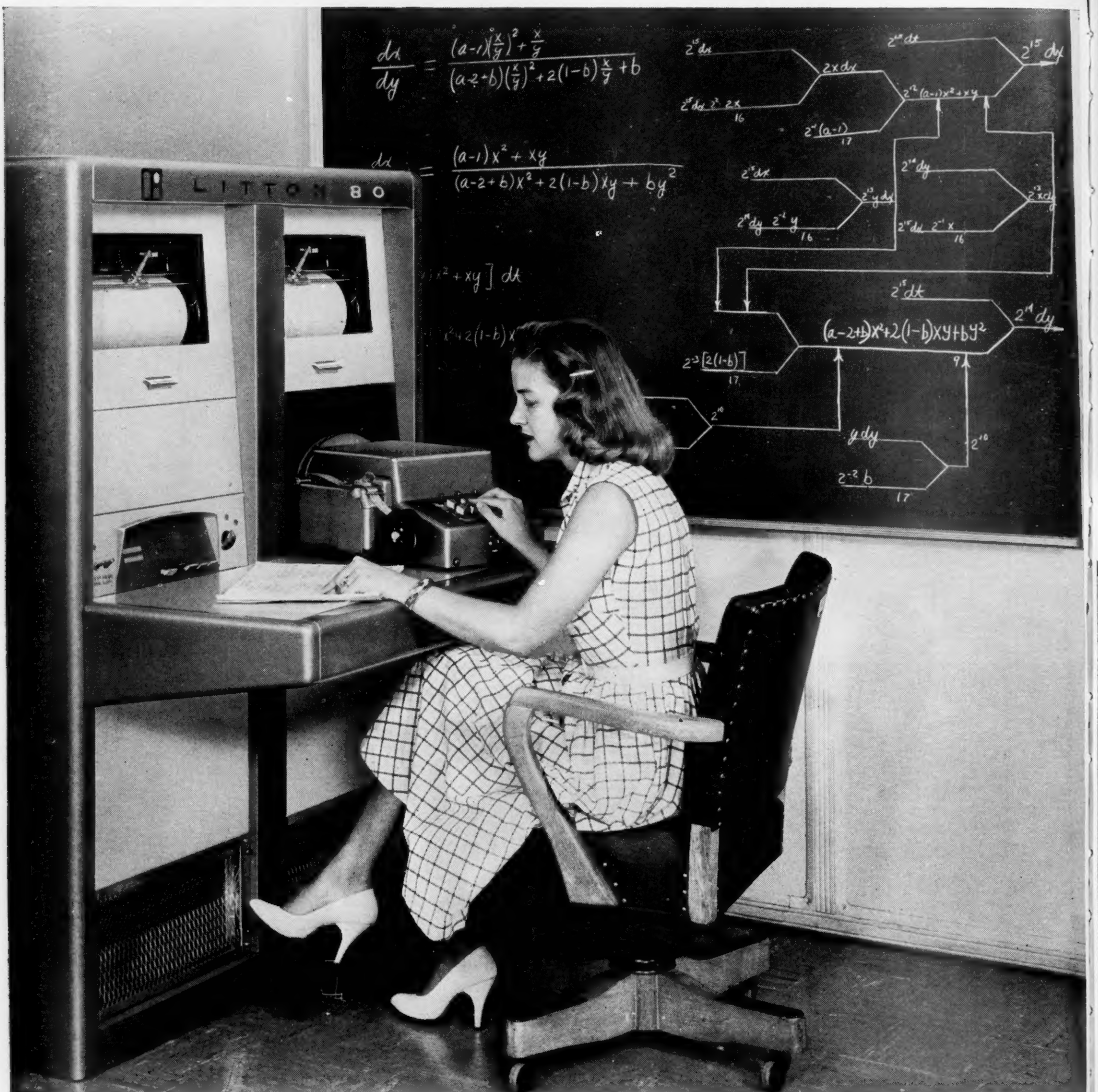
1. What Is "Operating a Computer" Like?

The new Computing Center at the Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Pa., showing its powerful modern automatic digital computer, a Remington Rand Univac. The central machihe is the supervisory control. (Figure 1)

Another view of the same center, looking from the opposite direction. The machines at the left (Uniservos) are magnetic tape handlers. (Figure 2)

Operating the Bizmac, a very large automatic electronic computer, made by Radio Corporation of America, and installed at the Detroit headquarters of the Army Ordnance Tank-Automotive Command. The Bizmac system includes about 220 units of nineteen different types of equipment. (Figure 3)

The "System Central" of the RCA Bizmac in Detroit, which functions like a telephone exchange. An operator at any one of these consoles can connect any of the 182 magnetic tape stations to the appropriate data processing machine by pressing a button; and she can tell from a glance at the control panel which machines are busy and which can take on a new job. (Figure 4)



Operating a small automatic combined-digital-analog computer, mainly used for solving differential equations: the Litton-80 Digital Differential Analyzer, made by Litton Industries, Beverly Hills, Calif. This computer contains 80 integrators. The computer controls are at the left at desk level. The girl operating the machine is using the paper tape punch, at the right at desk level. The drums at the top of the machine give graphical output, and may take in graphical input. (Figure 5)

(Above)

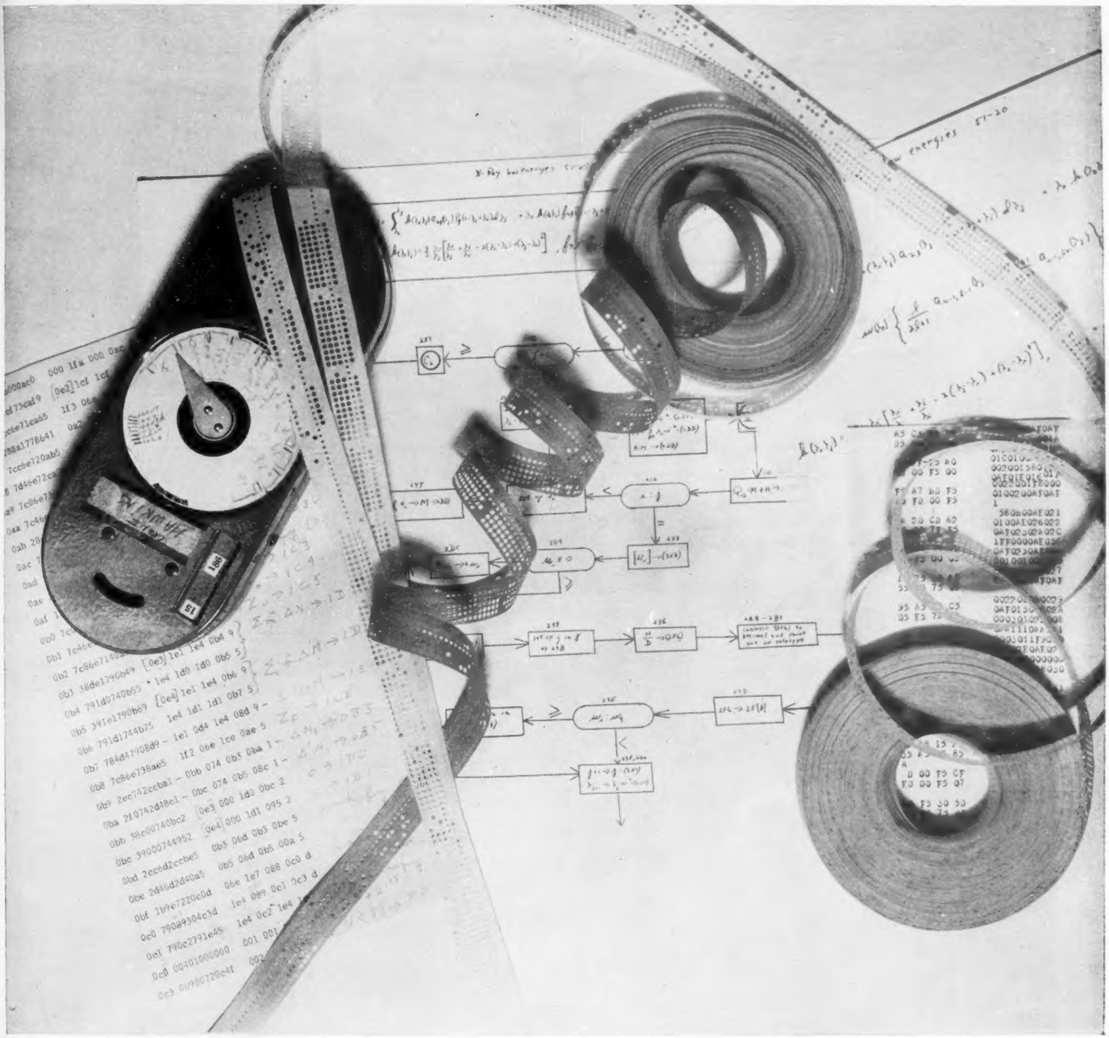
Operating a small automatic digital computer, which can be used for computations ranging from actuarial mathematics to jet plane design. This is International Business Machine Corp. Type 610 Auto-Point Computer, a "desk-side" machine, with automatic positioning of the decimal point. At the extreme right are the main input keys; next is an electric typewriter for output. (Figure 6)

(At left)

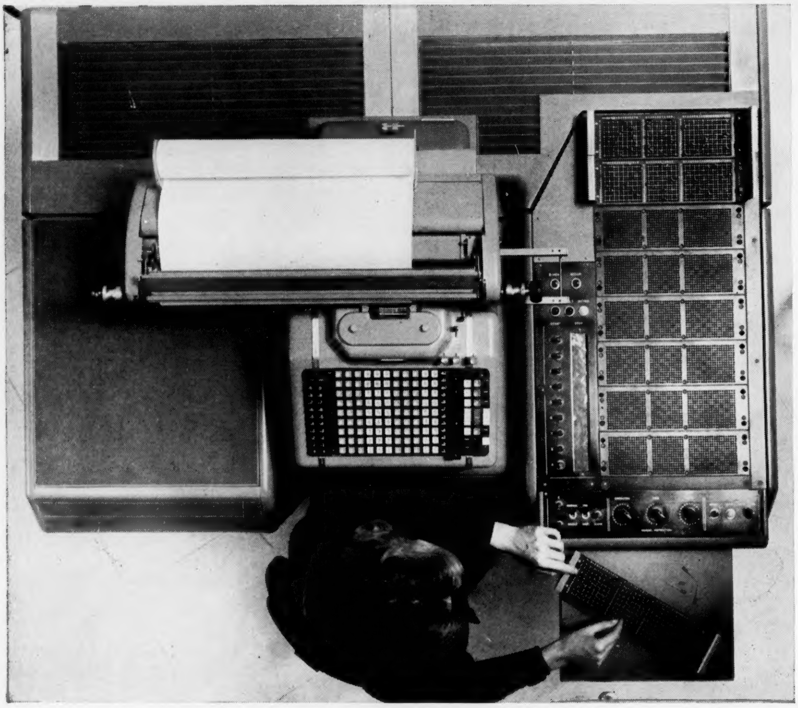
Operating a medium-sized automatic digital computer in the Naval Ordnance Laboratory near Washington, D.C. This computer is the Datatron 205, made by ElectroData Division of Burroughs Corp., Pasadena, Calif. It is in use for solving engineering and scientific problems. (Figure 7)

2. What Is "Computer Programming Like?

Most of the time the programming of an automatic computer, the long sequence of instructions, is quite invisible. It is stored within the machine. But every now and then it becomes visible to some extent. Here are a few pictures in which programming is "visible."



A mathematical formula is reduced to a flow pattern. The programming is worked out in a series of instructions. For example, the sixth instruction from the bottom is:
0be 2d46d2940a5   0b5 06d 0b5 00a 5
The instructions are then punched on paper tape, converted into polarized spots on magnetic wire, and fed to SEAC, the National Bureau of Standards Eastern Automatic Computer, Washington, D.C. This machine began to be dismantled in 1957, but did much useful work before then. Reason: the cost of maintenance on SEAC became greater than the sum of the amortized cost and the cost of maintenance on a new, more powerful computer. (Figure 8)



(At left)

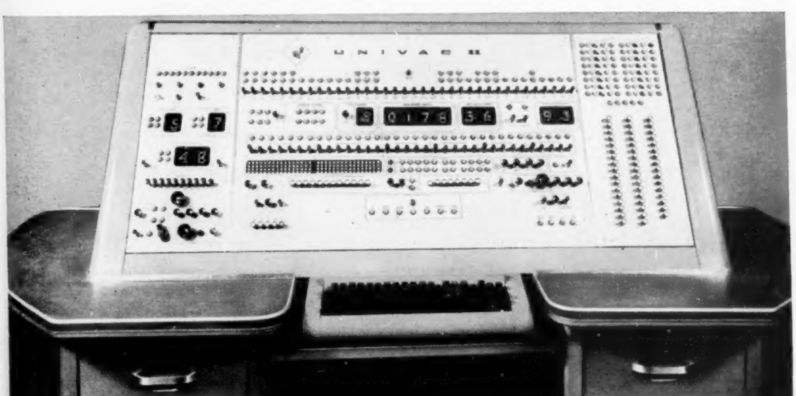
Here a programmer places pins into a pinboard, which placed in a receptacle expresses the programming of the computer. The computer is a general-purpose desk-size automatic digital computer, the Burroughs Corp. Type E 101, marketed by the ElectroData Division of Burroughs, Pasadena, Calif. The picture is taken looking vertically downward. (Figure 9)

Above is a punched paper roll which automatically programs the keys of an electric typewriter, so that it will print any desired stored words or sentences. The machine is the Autotypist, made by the American Automatic Typewriter Co., Chicago. (Figure 10)

Below is the wired plugboard of the Underwood Typewriter Co.'s Dataflo, which programs that machine. (Figure 11)

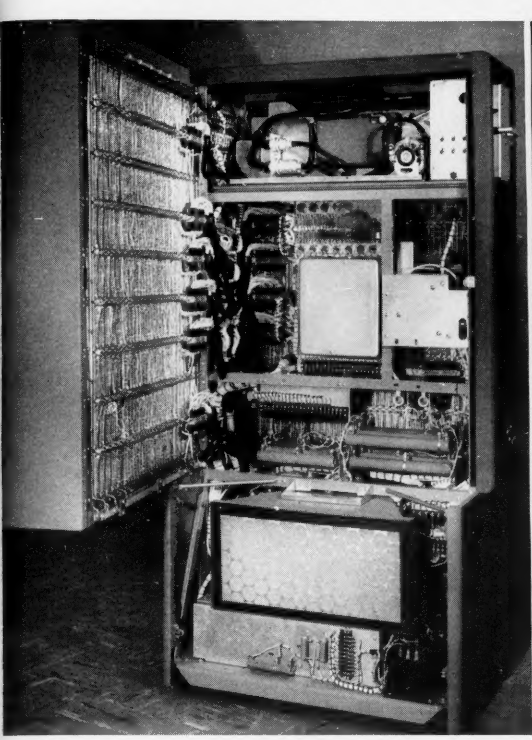
William Snow and Miss Loretta Kassel, programmers, check a program of instructions at the supervisory console of GEORGE, new automatic electronic computer installed in 1957 at Argonne National Laboratory, Lemont, Ill. Snow is feeding punched paper tape through a high-speed photo-electric reader. The reader, manufactured by Ferranti Electric, is capable of reading 200 characters per second. Miss Kassel checks data coming from an automatically controlled electric typewriter, a means of output used here to obtain results from the program at a speed slower than usual. The typewriter, made by International Business Machines Corp., was modified for computer use by Soroban Engineering, Inc.

GEORGE is one of two high-speed digital electronic computers recently installed for the Argonne Applied Mathematics Division. It was designed and manufactured in part by the Argonne Electronics Division. It has a random-access magnetic-core memory of 4,096 words of 40 binary digits. A magnetic tape supplemental memory of Argonne-developed design is being constructed for this computer. (Figure 12)

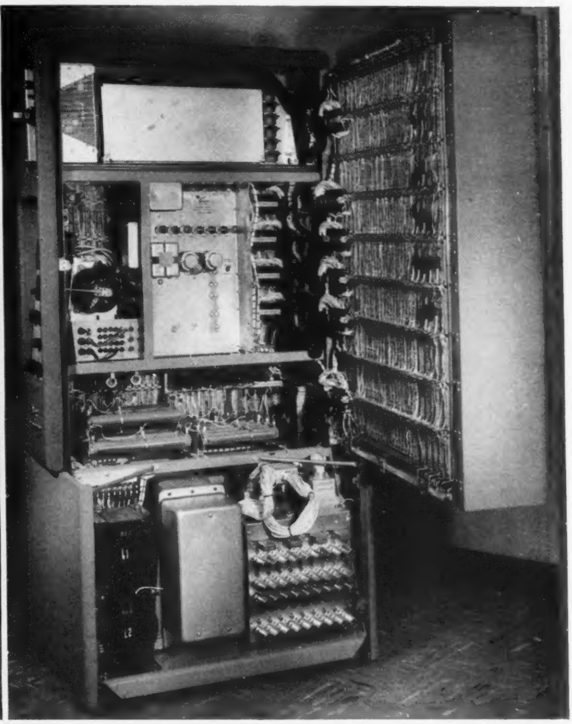


The supervisory control of Univac II, a very large high speed automatic computing system, made by Remington Rand Univac. The key board on the panel enables the operator to "talk" to the computer; a control printer enables the computer to "talk back" to the operator. (Figure 13)

3. What does the Inside of a Computer Look Like?

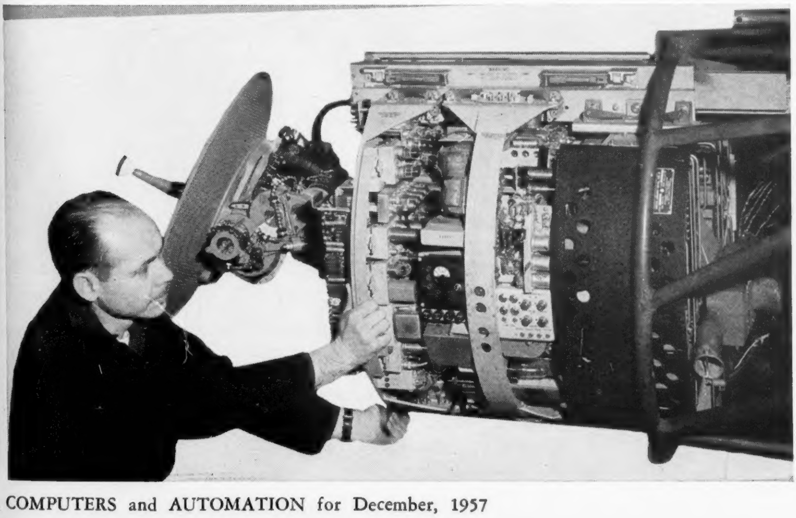


(Figure 14)

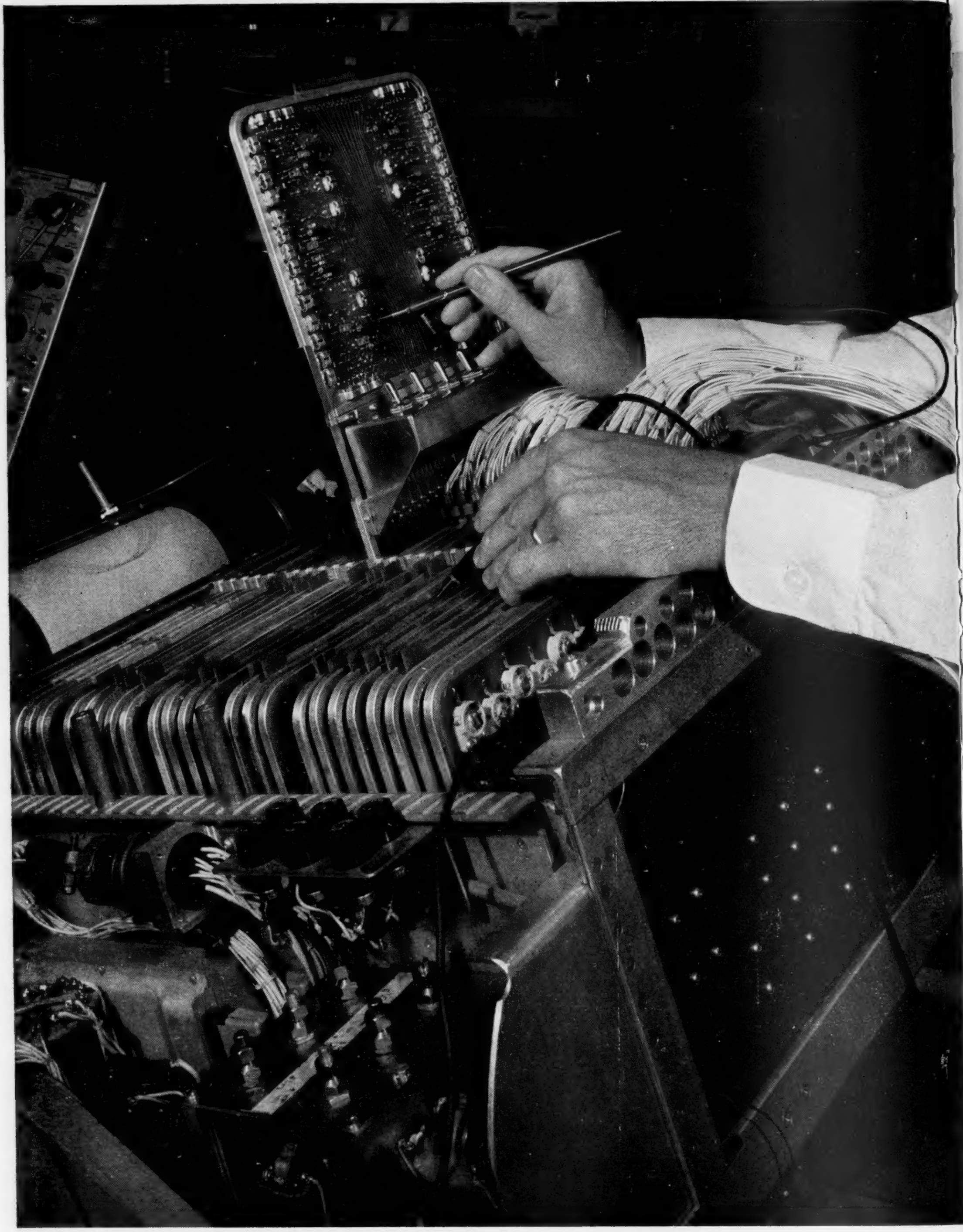


(Figure 15)

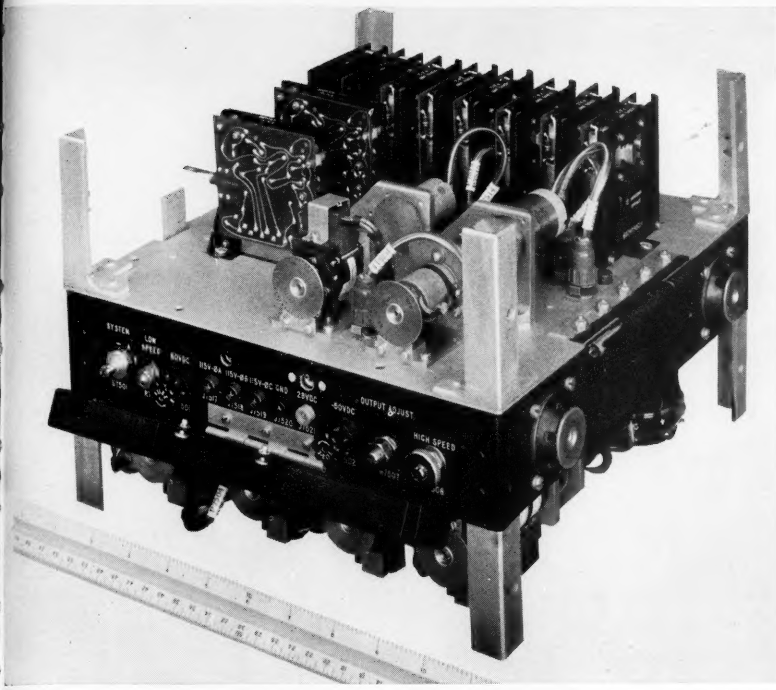
Here are two pictures of the inside of the Bendix G 15, a general purpose automatic digital computer made by the Bendix Computer Division, Los Angeles 45, Calif. The front of the computer faces the center of the page; what you see when the left side door is opened appears in Figure 14; and what you see when the right side door is opened appears in Figure 15. Also, the bottom side panels of the machine have been taken off for these pictures. The two doors contain all the plug-in circuit boards and the logical wiring of the computer. The top of the computer contains a pull out drawer which holds the paper tape punch and the photoelectric reader of paper tape. The bottom of the computer contains the magnetic drum memory, the power supply and the blower.



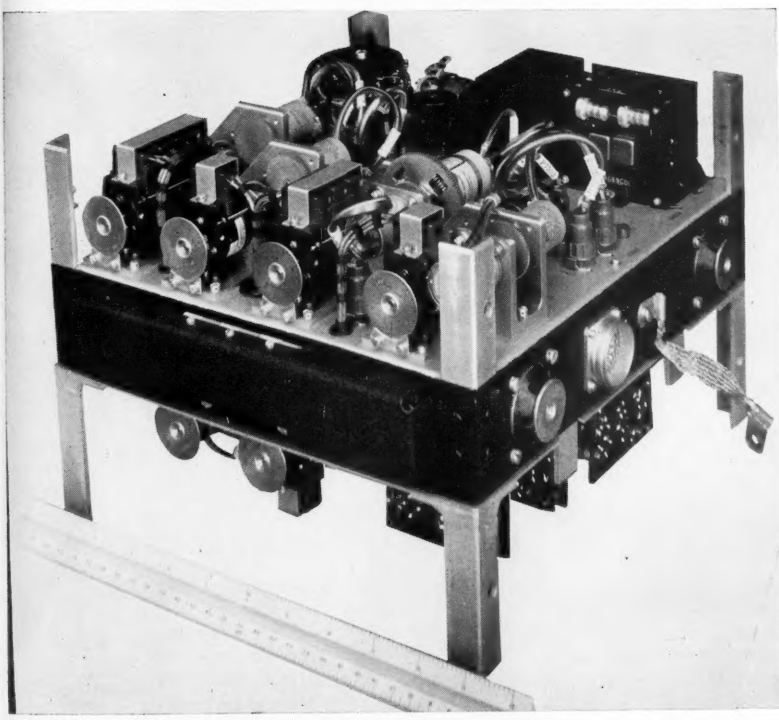
The inside of an airplane fire control computer installed in a U.S. Navy interceptor aircraft. The computer is an Aero 13 made by Westinghouse Electric Corp., Baltimore, Md. The fire control computer is mounted integrally with the radar at the rear of the assembly. (Figure 16)



The inside of an airborne automatic digital computer of the differential analyzer type. This computer is made by Autonetics, Division of North American Aviation Inc., Downey, Calif., and it automatically and continuously processes data gathered while an airplane is in flight. It is able to perform 93 distinct integrations, generate continuous solutions of differential equations, and calculate trigonometric functions. The computer occupies 3 cubic feet, weighs 145 pounds, and uses 100 watts of power. All vacuum tubes have been replaced by transistors. (Figure 17)



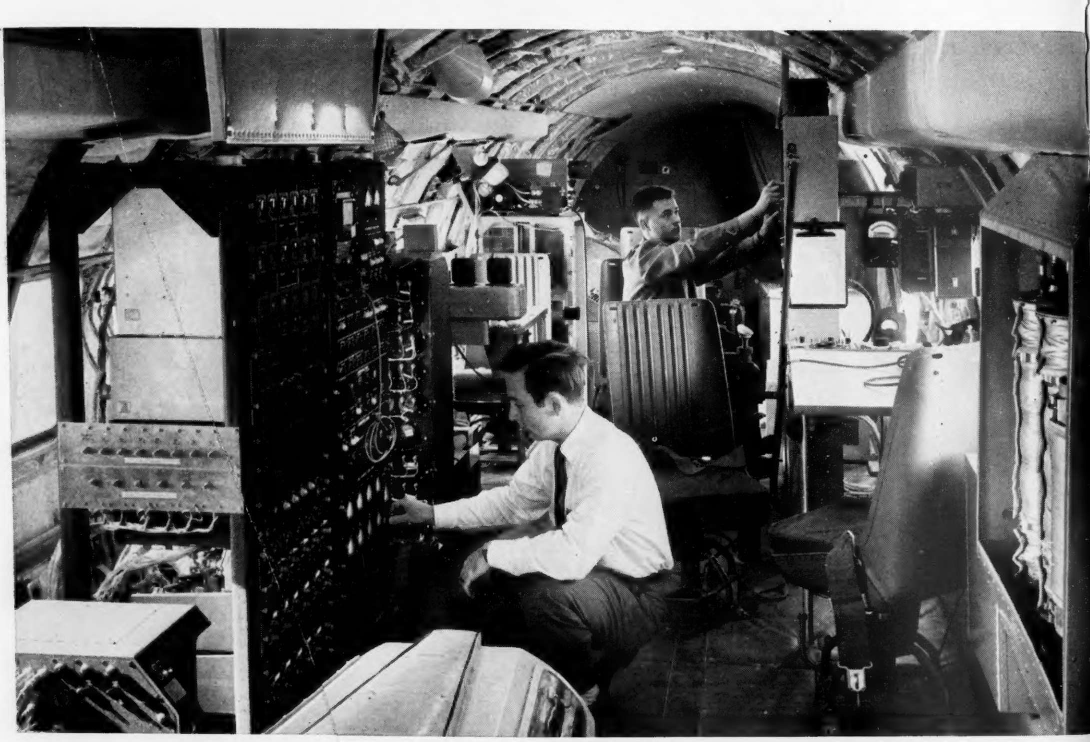
This is the upper chassis of a computer made by Westinghouse Electric Co., Air Arm Div., Baltimore, Md. It is a miniaturized analog computer less than 12 inches across, for air navigation purposes. The upper chassis shows six transistorized servo amplifiers, of the plug-in type and completely interchangeable. (Figure 18)



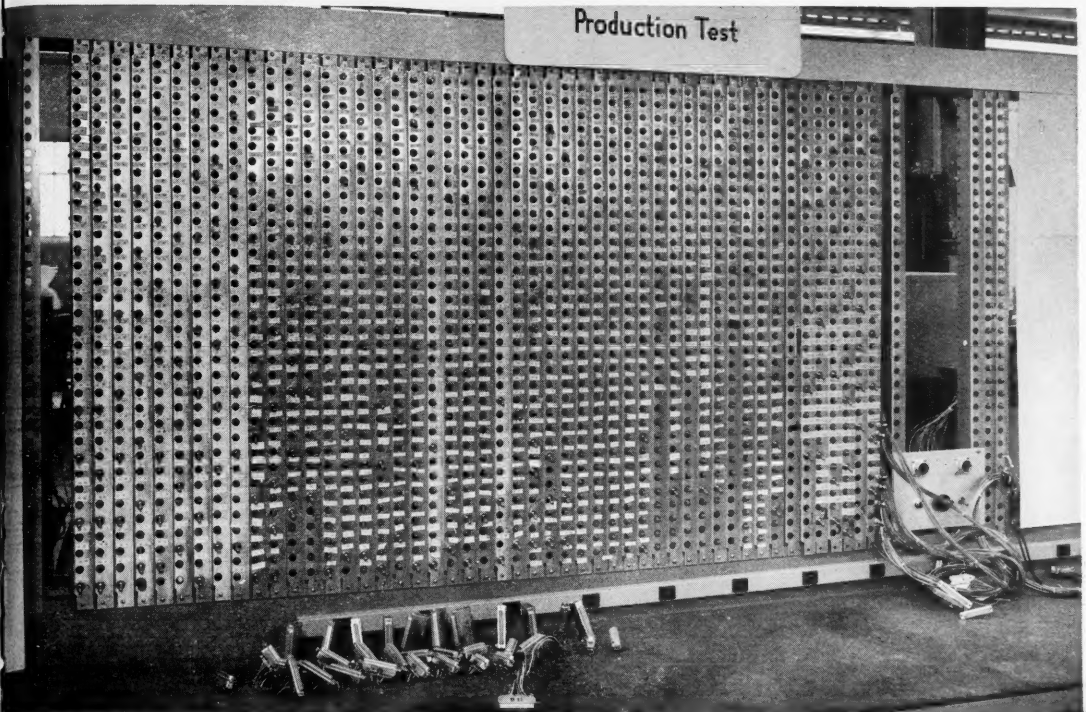
The lower chassis of the same computer, showing the arrangement of the servo motors, gear boxes, resolvers, "pot gangs," and transistorized power supply. (Figure 19)

4. What does Producing and Testing a Computer Look Like?

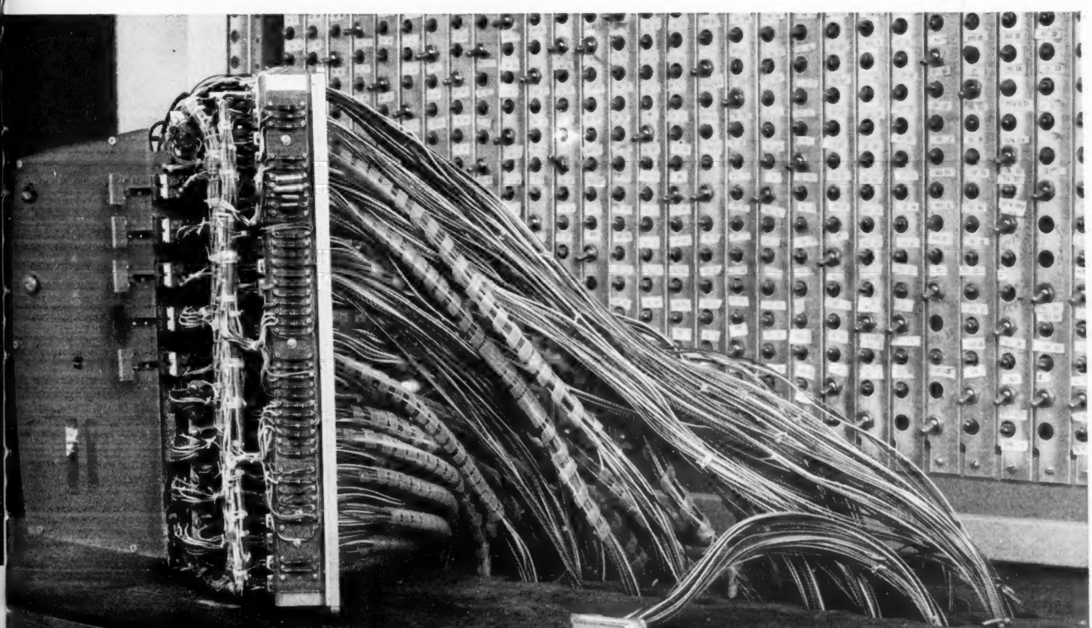
Production line of the Endicott, N.Y., plant of International Business Machines Corp., where the IBM 650 automatic digital computer is assembled. Over 500 of these computers have been delivered. (Figure 20)



A computing system test laboratory that flies in a T-29 aircraft. It tests automatic navigation systems using advanced radar, autopilot, and inertial navigation. The laboratory includes dozens of special instruments and data gathering devices so that actual performance of systems can be evaluated. Two research engineers are making final checks before the flight test by Autonetics, Division of North American Aviation, Inc., Downey, Calif. (Figure 21)

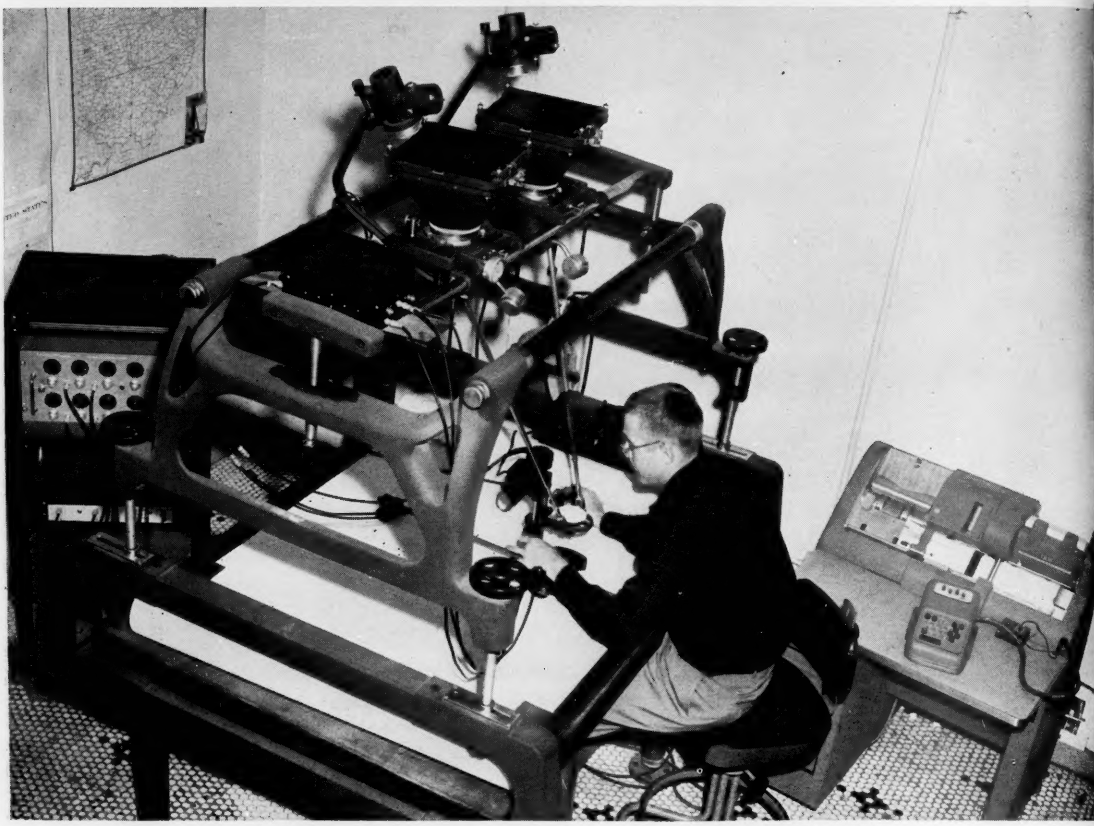


This piece of equipment checks the wiring of the digital differential analyzer made by Litton Industries, Beverly Hills, Calif. The 33 plugs at the bottom of the picture resting on the bench connect with the machine. The apparatus detects and locates open and shorted circuits which may occur in over 2000 soldered connections in the computer. (Figure 22)

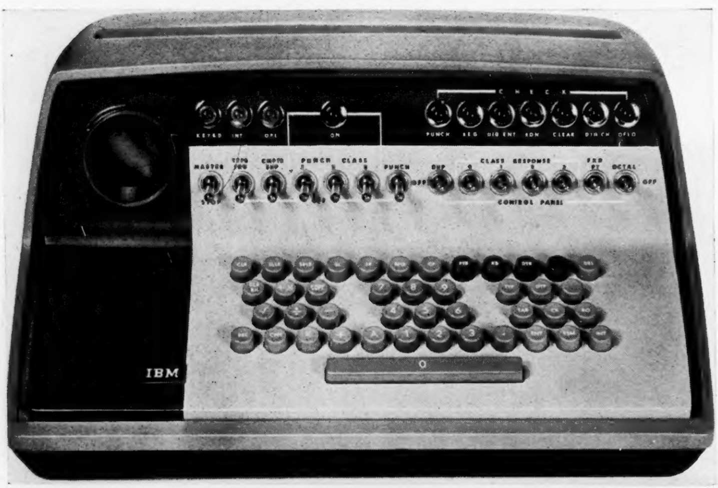


Here is a Litton digital differential analyzer on the bench and being checked. (Figure 23)

5. What does Input to a Computer Look Like?



This is an automatic data input system used with a Kelsh Photogrammetric plotter. It speeds up the recording of horizontal and vertical measurement readings needed by highway engineers. This equipment was developed in a research program for the Ohio State Department of Highways, Columbus, Ohio, by Battelle Memorial Institute. The photogrammetric plotter, a standard highway engineering tool, is used to make many measurements from aerial photographs that formerly had to be made in the field by survey crews. The data recording device (left), when used with the plotter, makes it possible to automatically record measurements on punch cards in the IBM punch card unit (right). The cards are immediately available for computation of quantities of cut and fill earth work. (Figure 24)



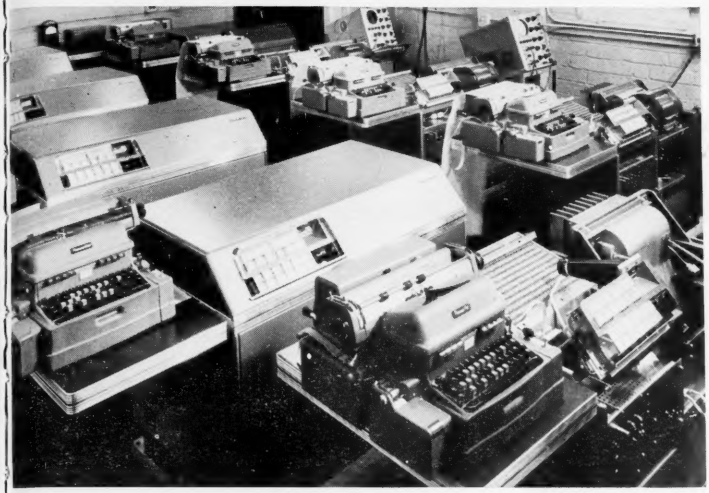
This is the input keyboard of the Type 610 Auto-Point Computer made by International Business Machines Corp. It enables a mathematician to solve a problem manually, and at the same time prepare a program tape so that all similar problems can be rerun automatically. Data can also be entered via this keyboard into tape for future use. (Figure 25)

[Please turn to page 28]

Annual Index to "Computers and Automation"

[Continued from page 4]

Readers' and Editor's Forum [Continued]



Above is a view of the assembling of a small-size yet powerful automatic electronic digital computer, the Royal Precision LGP-30, at the plant of Librascope, Glendale, Calif., subsidiary of General Precision Equipment Corp., who have joined with Royal McBee Corp., Port Chester, N.Y., to market the LGP-30.

[Continued from page 9]

sures Resulting From a Break in High Pressure–High Temperature Water Lines," "Simulation of Temperature Transients Resulting From Compartment Ventilation Failure," "Brake Drum Temperature Distribution," Berkeley Ease analog. B. L. Jones, Senior Design Supervisor, Atomic Power Research Department, Newport News Shipbuilding and Dry Dock Company, Newport News, Virginia.

"Pipe Stress Analysis," "Spectroscopy Analysis," "Gyro Sea Test Results," "Transistor Reliability Study," Univac 1, Capt. A. L. Rosenstein, Industrial Engineering Officer, New York Naval Shipyard, Naval Base, Brooklyn 1, New York.

"N. A. Hydrostatic Curves," "Section Modulus Tables," and "Weight and Moment Summaries," IBM 650, Warren C. Galle, Section Head, Engineering Computation Section, Portsmouth Naval Shipyard, Portsmouth, New Hampshire.

"Tank Capacities," IBM 604, Joe D. Smith, Assistant Engineer, Avondale Marine Ways, Inc., P.O. Box 1030, New Orleans, Louisiana.

"Wave Spectrum of 125 M.P.H. Winds," "Wave Forces of 125 M.P.H. Winds on Drilling Structures," "Force Analysis of Space Structures With 15 Redundant Elements," "Determining of Section Moduli of Plate and Angle Combinations," and "Development of S/A of Plate and Angle Combinations," IBM 604, M. J. Wood, Engineer, Design Department or J. R. Fahey, Manager, Machine Department, Higgins, Inc., P.O. Box 8001, New Orleans, Louisiana.

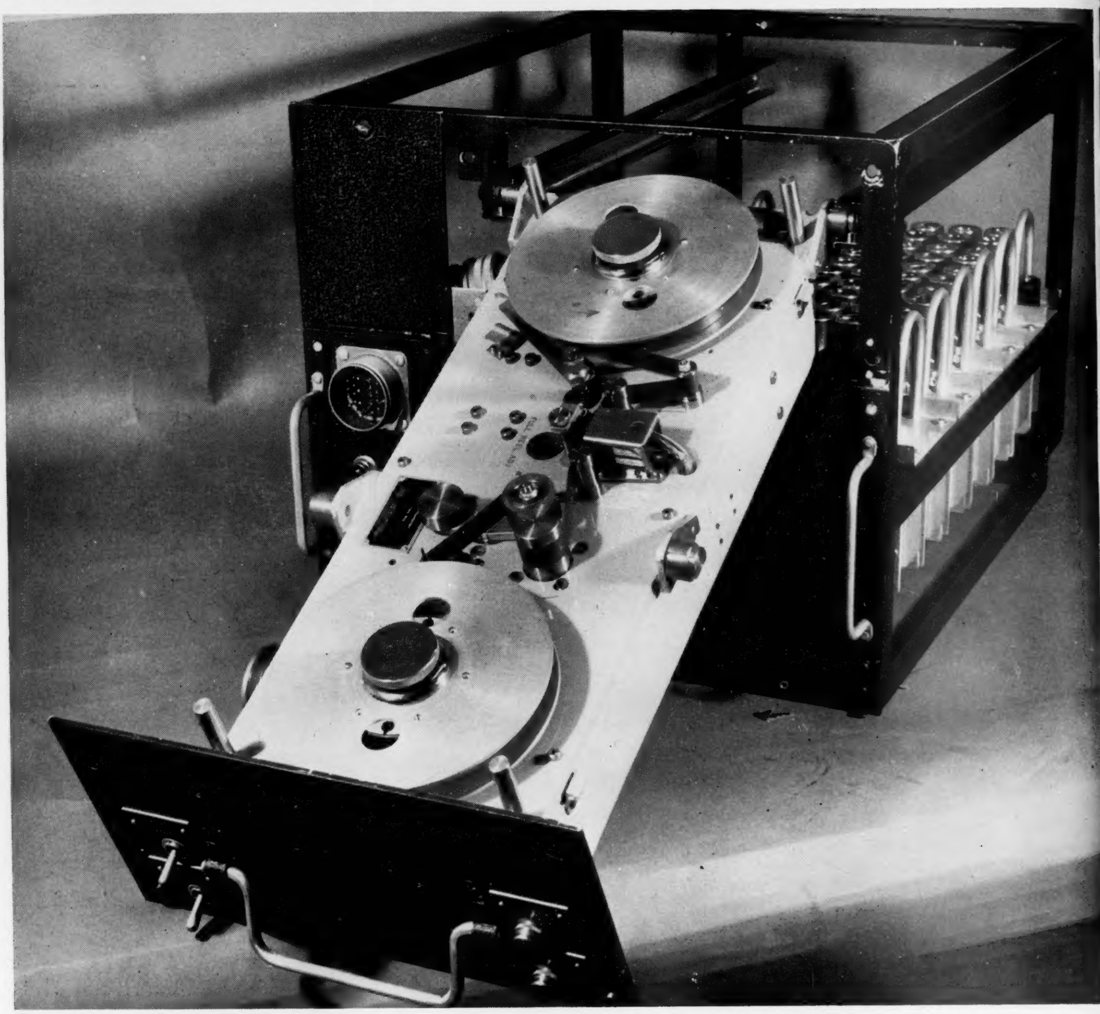
The above does not include all of the shipyards which are using high speed automatic computers. A few of the users did not answer the questionnaire while some who listed problems they are solving did not indicate that they will release information about them.

Annual Index

[Continued from page 26]

[Please turn to page 33]

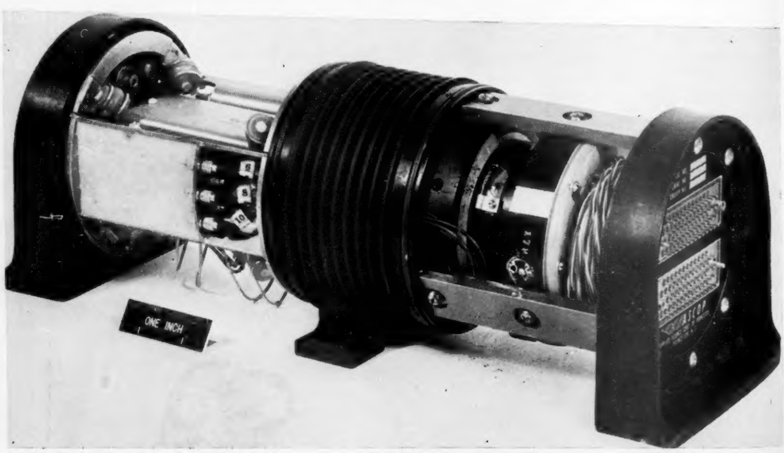
 [Continued from page 24]

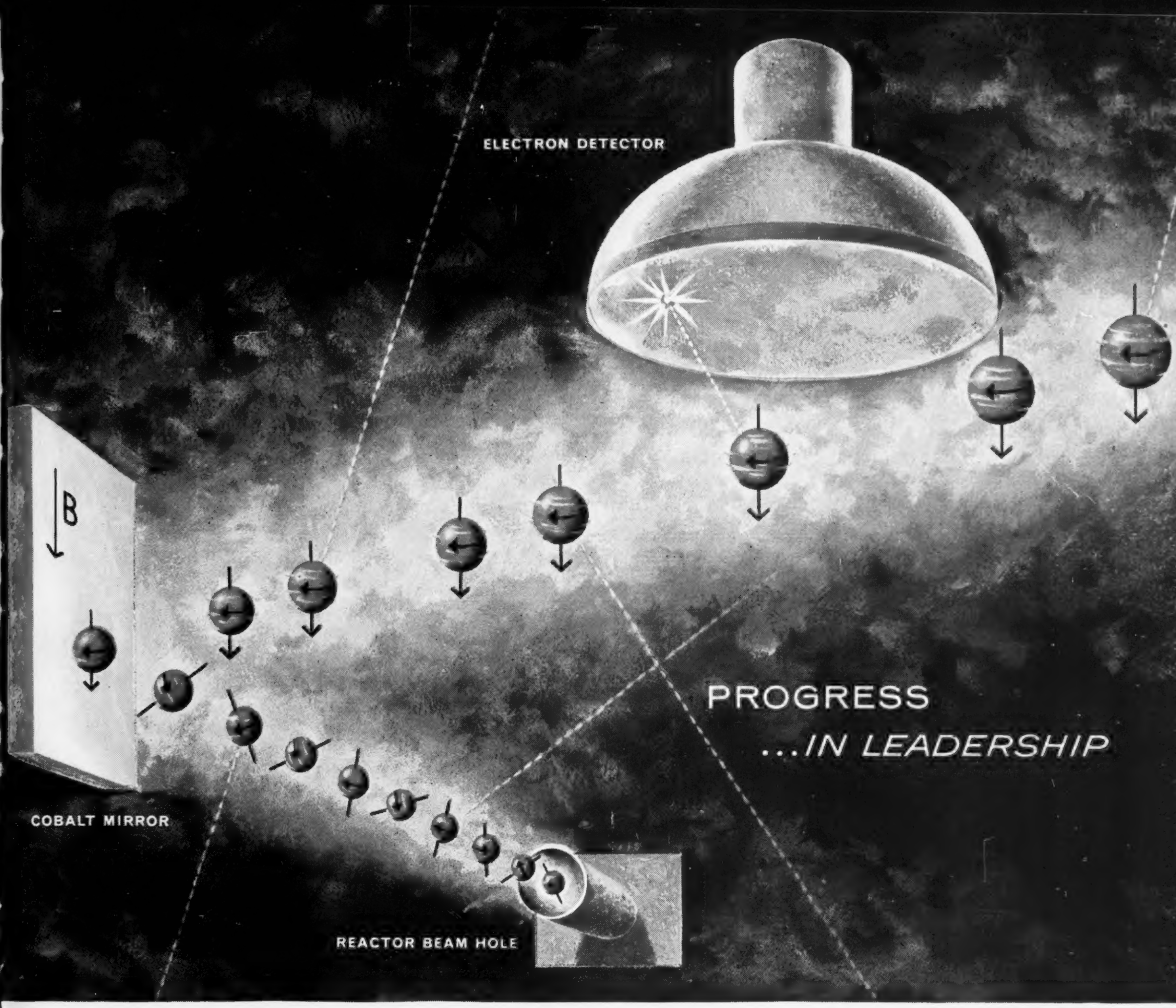


This is an airborne digital input recorder made by General Precision Laboratories, Pleasantville, N.Y. It will record on one-half inch wide magnetic tape a great quantity of data accurately. The digital form of the recorded data is compatible with International Business Machines Corp. computers Type 650, 704, or 705. In a typical application, the data from ten hours of recording of information in an airplane can be inserted into a computer in six minutes. (Figure 26)

(At right)

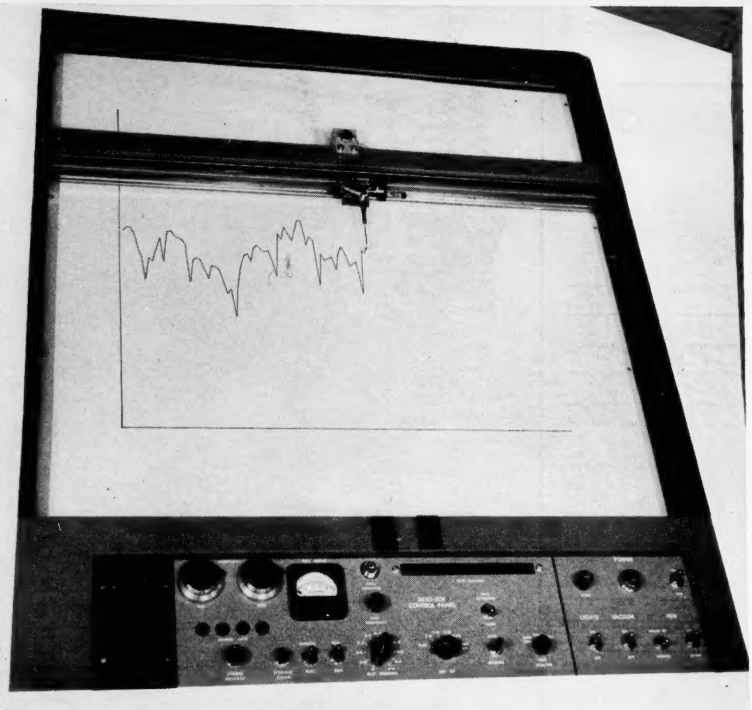
This device installed in an aircraft or missile takes in data from very sensitive gauges that report pressure, or strain, or temperature, and other kinds of transducers giving electrical signals in the range from zero to 15 or 30 millivolts. It is called the Low-Level Multicoder and is made by Applied Science Corporation of Princeton, N.J. (Figure 27)




ELECTRON DETECTOR
B
PROGRESS
...IN LEADERSHIP
COBALT MIRROR
REACTOR BEAM HOLE

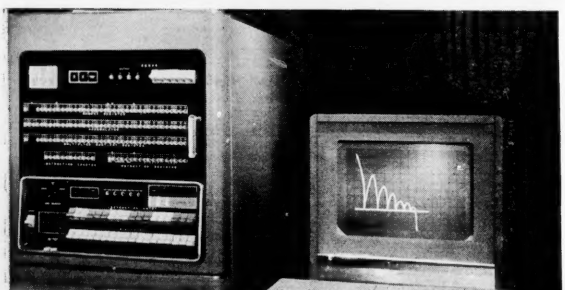
6. What does Output from a Computer Look Like?

A digital printer, made by Radiation Inc., Melbourne, Fla., which produces 180 lines of printing per second, each line containing 12 numeric characters. The paper issuing from the machine is electrosensitive, marked by current passing through it. Each numeric digit consists of a selection out of an array of 30 points, 5 wide by 6 high. The speed of over 2000 characters per second is only about 500 times faster than a human being. (Figure 28)



An electronically controlled maker of graphs, called the Dataplotter, made by Electronic Associates, Long Branch, N.J. It makes possible fast, automatic graphing of the information that can pour out of an electronic business computer. It will pick up the location of a point from a punched card, or punched paper tape, or magnetic tape; store the information in a memory device; pick up the location of a second point from a second source; refer to its memory for the location of the first point; and draw a continuous line between the two points. It requires 1 and ⅔ seconds for this process; and then will repeat the process over and over again. For example, this machine will make a cross sectional graph of a mile of highway in 20 minutes.

(Figure 29)



The visual display of the International Business Machines' Type 740 Output Recorder. Here, pictured on the face of a 21-inch cathode ray tube, are curves automatically traced showing the theoretical path of a bouncing ball as calculated by a big computer. (Figure 30)

A machine which types a purchase order or other basic record, and at the same time punches paper tape or cards — a combined input-output machine. This is the Flexowriter, made by Friden Calculating Machine Co., San Leandro, Calif. (Figure 31)

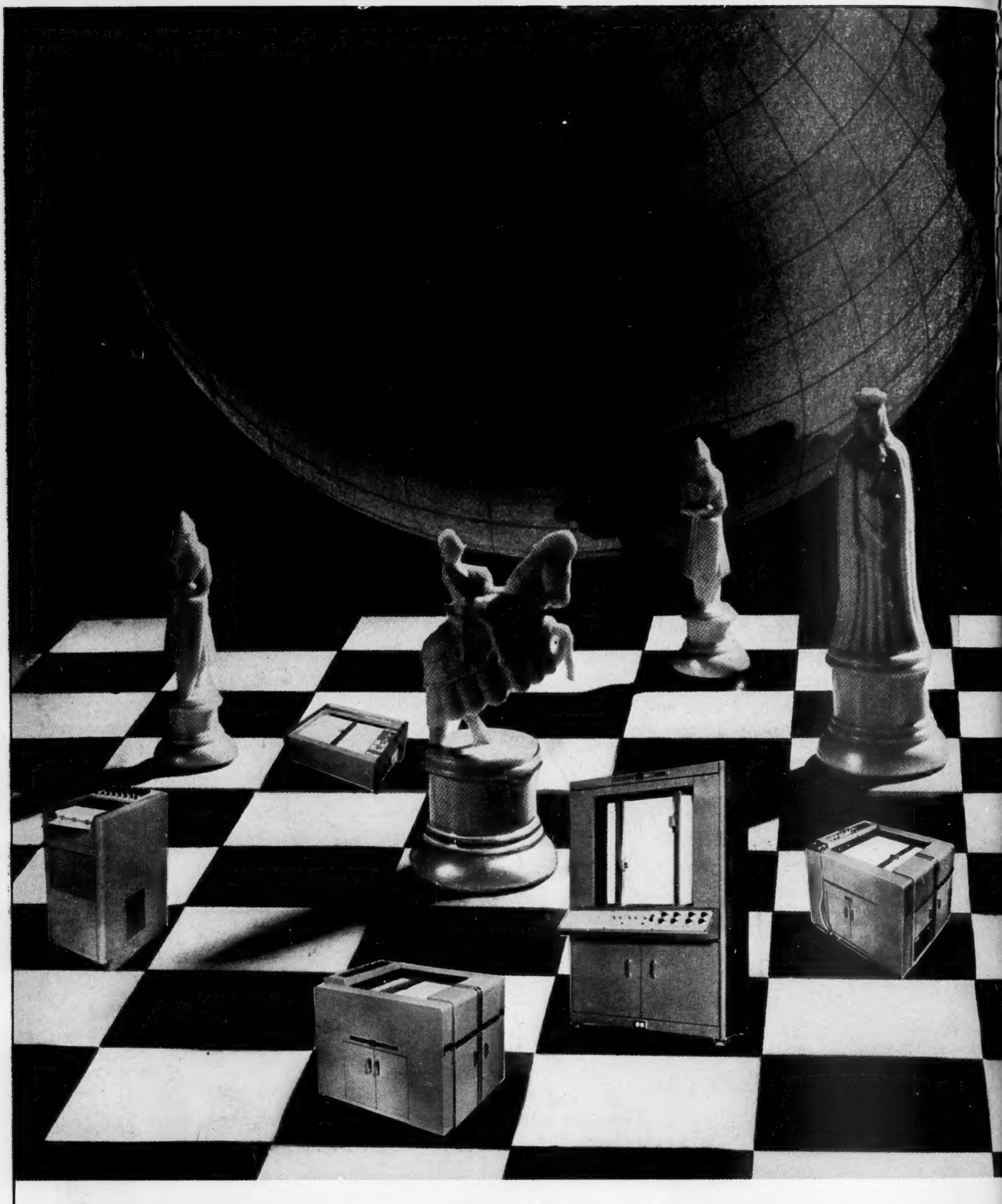
Annual Index

[Continued from page 27]

[Continued in January Issue]

ADVERTISING INDEX

Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where the advertisement appears / name of the agency if any.



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